University of Gdańsk

Subject card

Subject name and code	Computational Group Theory, PG_00174263		
Field of study	Mathematical Modeling and Data Analysis		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	6.0
Learning profile	academic	Assessment form	exam
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor	dr Rafał Lutowski	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	30.0	0.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	0.0	0.0	60

Subject objectives

The purpose of the course is to familiarize students with the basic algorithms of computational group theory and the GAP program.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[MMiADL3_K02] is ready to precisely formulate questions to deepen his/her own understanding of a given topic or to find missing elements of reasoning	The student can formulate precise questions that support solving problems in group theory using the GAP system, particularly to deepen understanding of algorithm behavior and interpretation of results.	[SK5] implementation of a problem task [SK8] observation of student's independent or team work
[MMiADL3_U07] can comprehensively, in speech and in writing, formulate definitions and theorems and present correct mathematical reasoning regarding the issues learned	The student can construct proofs in the field of computational group theory, using tools from other areas of mathematics when necessary, such as linear algebra, number theory, or mathematical logic.	[SU4] test/exam - oral or written [SU5] implementation of a problem task
[MMiADL3_U08] is able to plan a way to solve a given problem and make a correct record of this solution, providing accurate and precise justifications for the correctness of their reasoning	The student can construct mathematical arguments in the field of computational group theory, including proving theorems and refuting hypotheses by building constructions and counterexamples, also using the GAP system.	[SU4] test/exam - oral or written [SU8] observation of student's independent or team work
[MMiADL3_W08] knows and understands well the role and importance of proof in mathematics, as well as the concept of the significance of assumptions	The student understands the importance of precise mathematical reasoning in computational group theory, can construct and analyze such reasoning, and recognizes its role in algorithm design and result verification, including through the use of the GAP system.	[SW4] test/exam - oral or written [SW5] implementation of a problem task

<table>
<tr><td>Subject contents</td><td>1. Definition and selected properties of groups
2. Group actions: arbits and stabilizers
3. Permutation groups:
• stabilizer chains
• Schreiera-Sims algorithm
• ,,backtrack" algorithms
• natural actions and decompositions
• primitive groups
• composition series
4. GAP - groups, algorithms, programming
• examples of theoretical concepts
• GAP kernel - extending functionality</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basic knowledge of group theory and related algebraic objects.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>test</td><td>51.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Alan F. Beardon, Algebra and Geometry, Cambridge University Press, 2005
2. Alexander Hulpke, Notes on Computational Group Theory, https://www.math.colostate.edu/~hulpke/CGT/cgtnotes.pdf
3. Various authors, documentations and tutorials for GAP, https://www.gap-system.org/Doc/doc.html</td></tr>
<tr><td>Supplementary literature</td><td>1. Holt, D. F., Eick, B., & O'Brien, E. A. (2005). Handbook of Computational Group Theory. Chapman & Hall/CRC</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Determine the orbit of a group action.
2. Determine the stabilizer of a group action.
3. Determine stabilizer chain.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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